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Please contact Linda Hughes at 360-709-5412 with comments, questions, or suggestions for improvement to the manual.

Instructions for Printed Manuals

Page numbers indicating portions of the manual that are to be removed and inserted are shown below.

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Washington State
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TECHNICAL MANUAL

Materials Manual

M 46-01.04

Hsjw 2010

Environmental and Engineering Programs

Materials Laboratory

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WSDOT FOP FOR WAQTC/AASHTO T 27/T 11[1]

Sieve Analysis of Fine and Coarse Aggregates

Significance

Sieve analyses are performed on aggregates used in roadway bases and in portland cement and asphalt cement concretes. Sieve analyses reveal the size makeup of aggregate particles – from the largest to the smallest. A gradation curve or chart showing how evenly or unevenly the sizes are distributed between largest and smallest is created in this test. How an aggregate is graded has a major impact on the strength of the base or on the properties and performance of concrete. In portland cement concrete (PCC), for example, gradation influences shrinkage and shrinkage cracking, pumpability, finishability, permeability, and other characteristics.

Scope

This procedure covers sieve analysis in accordance with AASHTO T 27 and materials finer than No. 200 (75 µm) in accordance with AASHTO T 11. The procedure combines the two test methods.

Sieve analyses determines the gradation or distribution of aggregate particles within a given sample in order to determine compliance with design and production standards.

Accurate determination of material smaller than No. 200 (75 µm) cannot be made with AASHTO T 27 alone. If quantifying this material is required, it is recommended that AASHTO T 27 be used in conjunction with AASHTO T 11. Following AASHTO T 11, the sample is washed through a No. 200 (75 µm) sieve. The amount of material passing this sieve is determined by comparing dry sample masses before and after the washing process.

This procedure covers sieve analysis in accordance with AASHTO T 27 and materials finer than No. 200 (75 µm) in accordance with AASHTO T 11. The procedure includes two method choices, A, and B.

Note: All Field Operating Procedures (FOP's) referred to in this procedure are WSDOT FOP's.

Apparatus

- Balance or scale: Capacity sufficient for the masses shown in Table 2, accurate to 0.1 percent of the sample mass or better and conform to the requirements of AASHTO M 231.
- Sieves – Meeting the requirements of AASHTO M 92.
- Mechanical sieve shaker – Meeting the requirements of AASHTO T 27.
- Suitable drying equipment (see FOP for AASHTO T 255)
- Containers and utensils: A pan or vessel of a size sufficient to contain the sample covered with water and to permit vigorous agitation without loss of any part of the sample or water
- Optional Mechanical washing device

[1] This FOP is based on WAQTC FOP for AASHTO T 27/T 11 and has been modified per WSDOT standards. To View the redline modifications, contact WSDOT Quality Systems Manager (360) 709-5497.

Sample Sieving

In all procedures it is required to shake the sample over nested sieves. Sieves are selected to furnish information required by specification. The sieves are nested in order of decreasing size from the top to the bottom and the sample, or a portion of the sample, is placed on the top sieve. The sample may also be sieved in increments.

Sieves are shaken in a mechanical shaker for the minimum time determined to provide complete separation for the sieve shaker being used.

Time Evaluation

WSDOT has deleted this section.

Overload Determination

Additional sieves may be necessary to provide other information, such as fineness modulus, or to keep from overloading sieves. The sample may also be sieved in increments.

Additional sieves may be necessary to provide other information, such as fineness modulus, or to keep from overloading sieves. The sample may also be sieved in increments. For sieves with openings smaller than No. 4 (4.75 mm), the mass retained on any sieve shall not exceed 4 g/in^2 (7 kg/m^2) of sieving surface. For sieves with openings No. 4 (4.75 mm) and larger, the mass, in grams shall not exceed the product of 2.5 x (sieve opening in mm) x (effective sieving area). See Table 1.

Sieve Size US inches (mm)		8 φ (203)	12 φ (305)	12 x 12 (305 x 305)	14 x 14 (350 x 350)	16 x 24 (372 x 580)
		Sieving Area m^2				
		0.0285	0.0670	0.0929	0.1225	0.2158
3½	(90)	*	15.1	20.9	27.6	48.5
3	(75)	*	12.6	17.4	23.0	40.5
2½	(63)	*	10.6	14.6	19.3	34.0
2	(50)	3.6	8.4	11.6	15.3	27.0
1½	(37.5)	2.7	6.3	8.7	11.5	20.2
1	(25.0)	1.8	4.2	5.8	7.7	13.5
¾	(19.0)	1.4	3.2	4.4	5.8	10.2
⅝	(16.0)	1.1	2.7	3.7	4.9	8.6
½	(12.5)	0.89	2.1	2.9	3.8	6.7
⅜	(9.5)	0.67	1.6	2.2	2.9	5.1
¼	(6.3)	0.44	1.1	1.5	1.9	3.4
No. 4	(4.75)	0.33	0.80	1.1	1.5	2.6
Less than	(No. 4)	0.20	0.47	0.65	0.86	1.5

Note: Sample sizes above are in kilograms to covert: to grams multiple by 1,000. To convert to pounds multiple by 2.2.

Maximum Allowable Mass of Material Retained on a Sieve, kg
Table 1

Sample Preparation

Obtain samples in accordance with the FOP for AASHTO T 2 and reduce to the size shown in Table 2 in accordance with the FOP for AASHTO T 248.

If the gradation sample is obtained from FOP for AASHTO T-308, the Ignition Furnace, proceed to Procedure Method A, Step 2.

Nominal Maximum		Minimum Dry Mass	
Size* in.	(mm)	lb	kg
US No. 4	(4.75)	1	0.5
¼	(6.3)	2	1
⅜	(9.5)	2	1
½	(12.5)	5	2
⅝	(16.0)	5	2
¾	(19.0)	7	3
1	(25.0)	13	6
1¼	(31.5)	17	7.5
1½	(37.5)	20	9
2	(50)	22	10
2½	(63)	27	12
3	(75)	33	15
3½	(90)	44	20

Sample Sizes for Aggregate Gradation Test
Table 2

* For aggregate, the nominal maximum size, (NMS) is the largest standard sieve opening listed in the applicable specification, upon which any material is permitted to be retained. For concrete aggregate, NMS is the smallest standard sieve opening through which the entire amount of aggregate is permitted to pass.

Note: For an aggregate specification having a generally unrestrictive gradation (i. e. wide range of permissible upper sizes), where the source consistently fully passes a screen substantially smaller than the maximum specified size, the nominal maximum size, for the purpose of defining sampling and test specimen size requirements may be adjusted to the screen, found by experience to retain no more than 5% of the materials.

WSDOT Note 1: These sample sizes are standard for aggregate testing but, due to equipment restraints, samples may need to be partitioned into several "subsamples." See Method A.

Overview

Method A - This method is the preferred method of sieve analysis for HMA aggregate.

- Determine dry mass of original sample
- Wash through a No. 200 (75 µm) sieve
- Determine dry mass of washed sample
- Sieve material

Method B

- Determine dry mass of original sample
- Wash through a No. 200 (75 µm) sieve
- Determine dry mass of washed sample
- Sieve coarse material
- Determine mass of fine material
- Reduce fine portion
- Determine mass of reduced portion
- Sieve fine portion

Procedure Method A

1. Dry the sample in accordance with the FOP for AASHTO T 255, and record to the nearest 0.1 percent of total mass or better.
2. When the specification requires that the amount of material finer than No. 200 (75 µm) be determined, do Step 3 through Step 9 – otherwise, skip to Step 10.

   WSDOT Note 2: If the applicable specification requires that the amount passing the No. 200 (75 µm) sieve be determined on a portion of the sample passing a sieve smaller than the nominal maximum size of the aggregate, separate the sample on the designated sieve and determine the mass of the material passing that sieve to 0.1 percent of the mass of this portion of the test sample. Use the mass as the original dry mass of the test sample.
3. Nest a sieve, such as a No. 10 (2 mm), above the No. 200 (75 µm) sieve.
4. Place the test sample in a container and add sufficient water to cover it.

   WSDOT requires the use of a detergent, dispersing agent, or other wetting solution when washing a sample from FOP for AASHTO T 308, an ignition furnace sample.

   WSDOT Note 3: A detergent, dispensing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the No. 200 (75 µm) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.
5. Agitate vigorously to ensure complete separation of the material finer than No. 200 (75 µm) from coarser particles and bring the fine material into suspension above the coarser material. When using a mechanical washing device, exercise caution to not degrade the sample.
6. Immediately pour the wash water containing the suspended and dissolved solids over the nested sieves, being careful not to pour out the coarser particles.
7. Add a second change of water to the sample remaining in the container, agitate, and repeat Step 6. Repeat the operation until the wash water is reasonably clear.
8. Return all material retained on the nested sieves to the container by flushing into the washed sample.

   WSDOT Note 4: A suction device may be used to extract excess water from the washed sample container. Caution will be used to avoid removing any material greater than the No. 200.

9. Dry the washed aggregate in accordance with the FOP for AASHTO T 255, and then cool prior to sieving. Record the dry mass.
10. Select sieves to furnish information required by the specifications. Nest the sieves in order of decreasing size from top to bottom and place the sample, or a portion of the sample, on the top sieve.
11. Place sieves in mechanical shaker and shake for a minimum of 10 minutes, or the minimum time determined to provide complete separation if this time is greater than 10 minutes for the sieve shaker being used.
12. Determine the individual or cumulative mass retained on each sieve and the pan to the nearest 0.1 percent or 0.1 g.

    WSDOT Note 5: Use coarse wire brushes to clean the No. 40 (425 µm) and larger sieves, and soft bristle brushes for smaller sieves.

Calculations

The total mass of material after sieving should be verified with the mass before sieving. If performing T 11 with T 27 this would be the dry mass after wash. If performing just T 27 this would be the original dry mass. When the masses before and after sieving differ by more than 0.3 percent do not use the results for acceptance purposes. When performing the gradation from HMA using T 308, the masses before and after sieving shall not differ by more than 0.2%.

Calculate the total percentages passing, individual or cumulative percentages retained, or percentages in various size fractions to the nearest 0.1 percent by dividing the masses for Method A, or adjusted masses for Methods B and C, on the individual sieves by the total mass of the initial dry sample. If the same test sample was first tested by T 11, use the total dry sample mass prior to washing in T 11 as the basis for calculating all percentages. Report percent passing as indicated in the "Report" section at the end of this FOP.

Percent Retained:

Where:

IPR = Individual Percent Retained
CPR = Cumulative Percent Retained
M = Total Dry Sample mass before washing
IMR = Individual Mass Retained OR Adjusted Individual mass from Methods B or C
CMR= Cumulative Mass Retained OR Adjusted Individual mass From Methods B or C

$$IPR = \frac{IMR}{M} \times 100 \quad \text{OR} \quad CPR = \frac{CMR}{M} \times 100$$

OR

Percent Passing (Calculated):

Where:

PP = Percent Passing
PPP = Previous Percent Passing
PP = PPP-IPR OR PP = 100-CPR

Calculate cumulative percent retained on and passing each sieve on the basis of the dry mass of total sample, before washing. This will include any material finer than No. 200 (75 µm) that was washed out.

Divide the cumulative masses, or the corrected masses, on the individual sieves by the total mass of the initial dry sample (prior to washing) to determine the percent retained on and passing each sieve. Calculate the percent retained on and passing each sieve. Report percent passing as indicated in the "Report" section at the end of this FOP.

Example

Dry mass of total sample, before washing: 3214.0 g

Dry mass of sample, after washing out the No. 200 (75 μm) minus: 3085.1 g

For the ½ sieve:

Cumulative Mass retained on ½" sieve = 161.0 g

$$\text{Cumulative \% retained} = \frac{161.0}{3214.0} \times 100 = 5.0\% \text{ retained}$$

% passing = 100-5.0 = 95% passing ½" sieve

Sieve Size in. (mm)		Cumulative Mass Retained g	Cumulative Percent Retained	Reported Percent Passing*
¾	(19.0)	0	0	100
½	(12.5)	161.0	5.0	95
⅜	(9.5)	642.0	20.0	80
No. 4	(4.75)	1118.3	34.8	65
**No. 6	(3.35)	1515.2		
No. 10	(2.0)	1914.7	59.6	40
No. 40	(0.425)	2631.6	81.9	18
No. 80	(0.210)	2862.7	89.1	11
No. 200	(0.075)	3051.1	94.9	5.1
Pan		3086.4		

* Report No. 200 (75 μm) sieve to 0.1 percent. Report all others to 1 percent.

** Intermediate sieve used to prevent overloading the U. S. No. 10 sieve.

Gradation on All Screens

Test Validation: 3086.4 – 3085.1/3085.1 x 100 = 0.04 % which is within the 0.3 percent requirement and the results can be used for acceptance purposes.

Procedure Method B

1. Perform steps 1 thru 9 from the "Procedure Method A" then continue as follows:
2. Select sieves to furnish information required by the specifications. Nest the sieves in order of decreasing size from top to bottom through the No. 4 (4.75 mm) with a pan at the bottom to retain the minus No. 4 (4.75 mm). (See Table 1.)
3. Place sieves in mechanical shaker and shake for a minimum of 10 minutes, or the minimum time determined to provide complete separation if this time is greater than 10 minutes for the sieve shaker being used.
4. Determine the individual or cumulative mass retained on each sieve and the pan to the nearest 0.1 percent or 0.1 g. Ensure that all material trapped in the openings of the sieve are cleaned out and included in the mass retained. (See Note 5)
5. Determine the mass retained on each sieve to the nearest 0.1 percent of the total mass or better.
6. Determine the mass of the material in the pan [minus No. 4 (4.75 mm)].
7. Reduce the minus No. 4 (4.75 mm) using a mechanical splitter in accordance with the FOP for AASHTO T 248 to produce a sample with a mass of 500 g minimum. Determine and record the mass of the minus No. 4 (4.75 mm) split.
8. Select sieves to furnish information required by the specifications. Nest the sieves in order of decreasing size from top to bottom through the No. 200 (75 µm) with a pan at the bottom to retain the minus No. 200 (75 µm).
9. Place sieves in mechanical shaker and shake for a minimum of 10 minutes, or the minimum time determined to provide complete separation if this time is greater than 10 minutes for the sieve shaker being used.
10. Determine the individual or cumulative mass retained on each sieve and the pan to the nearest 0.1 percent or 0.1 g. Ensure that all material trapped in the openings of the sieve are cleaned out and included in the mass retained. (See Note 5)

Calculations

Compute the "Adjusted Cumulative Mass Retained" of the size increment of the original sample as follows when determining "Cumulative Mass Retained":

Divide the cumulative masses, or the corrected masses, on the individual sieves by the total mass of the initial dry sample (prior to washing) to determine the percent retained on and passing each sieve. Calculate the percent retained on and passing each sieve. Report percent passing as indicated in the "Report" section at the end of this FOP.

> When material passing the No. 4 (4.75 mm) sieve is split and only a portion of that is tested, the proportionate share of the amount passing the No. 200 (75 µm) sieve must be added to the sample mass to obtain a corrected test mass. This corrected test mass is used to calculate the gradation of the material passing the No. 4 (4.75 mm) sieve.

$$C = \left(\frac{M_1}{M_2} \times B \right) + D$$

where:

C = Total cumulative mass retained of the size increment based on a total sample

M_1 = mass of fraction finer than No. 4 (4.75 mm) sieve in total sample

M_2 = mass of reduced portion of material finer than No. 4 (4.75 mm) sieve actually sieved

B = cumulative mass of the size increment in the reduced portion sieved.

D = cumulative mass of plus No. 4 (4.75 mm) portion of sample.

Example:

Dry mass of total sample, before washing: 3214.0 g

Dry mass of sample, after washing out the No. 200 (75 µm) minus: 3085.1 g

Sieve Size in. (mm)	Cumulative Mass Retained g	Cumulative Percent Retained	Reported Percent Passing*
¾ (19.0)	0	0	100
½ (12.5)	161.0	5.0	95
⅜ (9.50)	642.0	20.0	80
No. 4 (4.75)	1118.3	34.8	65

Gradation on Coarse Screens

Pan = 1968.0

Test Validation : 1118.3 + 1968.0 – 3085.1/3085.1 x 100 = 0.04% which is within the 0.3 percent requirement and the results can be used for acceptance purposes.

The actual mass of material passing the No. 4 (4.75 mm) sieve and retained in the pan is 1968.0 g. This is M_1.

The pan (1968.0 grams) was reduced in accordance with the FOP for AASHTO T 248, so that at least 500 g are available. In this case, the mass determined was 512.8 g. This is M_2.

Sieve Size in. (mm)	Cumulative Mass Retained (g)
No. 4 (4.75)	0
No. 10 (2.00)	207.5
No. 40 (0.425)	394.3
No. 80 (0.210)	454.5
No. 200 (0.075)	503.6
Pan	512.8

Gradation on Fine Screens

Test Validation: 512.8 - 512.8/512.8 = 0.0 % which is within the 0.3 percent requirement and the results can be used for acceptance purposes.

For the No. 10 sieve:

M_1 = 1968.0g

M_2 = 512.8g

B = 207.5g

D = 1118.3g

$$C = \frac{M_1}{M_2} \times B + D = \frac{1968.0g}{512.8g} \times 207.5g + 1118.3g = 1914.7g$$

% retained $\frac{1914.7g}{3214.0g} = 59.6\%$

% passing = 100-59.6=40.4% reported as 40%

Final Gradation on All Screens

Sieve Size in. (mm)		Cumulative Mass Retained g	Adjusted Cumulative Mass Retained g	Cum. Percent Retained	Reported Percent Passing*
¾	(19.0)	0	0	0	100.0
½	(12.5)	161.1	161.1	5.0	95
⅜	(9.5)	642.5	642.5	20.0	80
No. 4	(4.75)	1118.3	1118.3	34.8	65
No. 10	(2.0)	207.5 x 3.838 + 1118.3	1914.7	59.6	40
No. 40	(0.425)	394.3 x 3.838 + 1118.3	2631.6	81.6	18
No. 80	(0.210)	454.5 x 3.838 + 1118.3	2862.7	89.1	11
No. 200	(0.075)	503.6 x 3.838 + 1118.3	3051.1	94.9	5.1
Pan		512.8 x 3.838 + 1118.3	3086.4		

* Report No. 200 (75 µm) sieve to 0.1 percent. Report all others to 1 percent.

Alternative Method B

As an alternate method to account for the fact that only a portion of the minus No. 4 (4.75 mm) material was sieved, multiply the fine screen "Percent Passing" values by the percent passing the No. 4 (4.75 mm) sieve obtained in the coarse screen procedure, 65 percent in this case.

The mass retained in the pan must be corrected to include the proper percent of No. 200 (.075 mm) minus material washed out.

Divide the cumulative masses, or the corrected masses, on the individual sieves by the corrected pan mass of the initial dry sample (prior to washing) to determine the percent retained on and passing each sieve. Calculate the percent retained on and passing each sieve. Report percent passing as indicated in the "Report" section at the end of this FOP.

Dry mass of total sample, before washing: 3214.0 g

Dry mass of sample, after washing out the No. 200 (75 µm) minus: 3085.1 g

Amount of No. 200 (75 µm) minus washed out: 3214.0 g – 3085.1 g = 128.9 g

Gradation on Coarse Screens

Sieve Size in. (mm)	Cumulative Mass Retained g	Cumulative Percent Retained	Reported Percent Passing*
¾ (19.0)	0	0	100
½ (12.5)	161.0	5.0	95
⅜ (9.50)	642.0	20.0	80
No. 4 (4.75)	1118.3	34.8	65

Pan = 1968.0

Test Validation : $\dfrac{1118.3 + 1968.0\text{-}3085.1}{3085.1} \times 100 = 0.04\%$

which is within the 0.3 percent requirement and the results can be used for acceptance purposes.

The actual mass of material passing the No. 4 (4.75 mm) sieve and retained in the pan is 1968.0 g. This is M_3.

The pan (1968.0 grams) was reduced in accordance with the FOP for AASHTO T 248, so that at least 500 g are available. In this case, the mass determined was 512.8 g. This is M_4.

Corrected pan mass = $M_4 + \dfrac{(M_4)(C_1)}{M_3}$

Where:

M_4 = mass retained in the pan from the split of the No. 4 (4.75 mm) minus.

M_3 = mass of the No. 4 (4.75 mm) minus of entire sample, not including No. 200 (.075 mm) minus washed out.

C_1 = mass of No. 200 (.075 mm) minus washed out.

Sieve Size in. (mm)	Cumulative Mass Retained (g)	Cumulative Percent Retained	Percent Passing
No. 4 (4.75)	0	0	100.0
No. 10 (2.00)	207.5	38.0	62.0
No. 40 (0.425)	394.3	72.2	27.8
No. 80 (0.210)	454.5	83.2	16.8
No. 200 (0.075)	503.6	92.2	7.8
Pan	512.8		

The corrected pan mass is the mass used to calculate the percent retained for the fine grading.

Example:

$M_4 = 512.8g$

$M_3 = 1968.0g$

$C_1 = 128.9g$

Corrected pan mass = $512.8g + \frac{(512.8g)(128.9g)}{1968.0g} = 546.4g$

For the No. 10 sieve:

Mass of No. 10 sieve = 207.5g

Corrected Pan Mass = 546.4g

Cumulative % retained = $\frac{207.5g}{546.4g} = 38.0\%$

% passing = 100-38.0 = 62.0%

Adjusted % passing No. 10 = % passing No. 10 x % No. 4 = 62.0 x 0.65 = 40%

Sieve Size in. (mm)		Adjustment	Reported Percent Passing*
¾	(19.0)		100
½	(12.5)		95
⅜	(9.5)		80
No. 4	(4.75)	100 x .65 =	65
No. 10	(2.00)	62.0 x .65 =	40
No. 40	(0.425)	27.8 x .65 =	18
No. 80	(0.210)	16.8 x .65 =	11
No. 200	(0.075)	7.8 x .65 =	5.1
* Report No. 200 (75 µm) sieve to 0.1 percent. Report all others to 1 percent			

Final Gradation on All Screens

SAMPLE CALCULATION FOR FINENESS MODULUS

Fineness Modulus (FM) is used in determining the degree of uniformity of aggregate gradation in PCC mix designs. It is an empirical number relating to the fineness of the aggregate. The higher the FM, the coarser the aggregate. Values of 2.40 to 3.00 are common for FA in PCC.

The FM is the sum of the percentages retained on specified ⅜″ (9.5 mm), No. 4 (4.75 mm), 2.36 mm (No. 8), 1.18 mm (No. 16), 0.60 mm (No. 30), 0.30 mm (No. 50), and 0.15 mm (No. 100) divided by 100 gives the FM.

The following example is for WSDOT Class 2 Sand:

WSDOT Class 2 Sand				
Sieve	**Size**	**% Passing**	**% Retained**	**% Retained on Specified Sieves**
⅜ in.	9.5 mm	100	0	0
No. 4	4.75 mm	100	0	0
No. 8	2.36 mm	87	13	13
No. 16	1.18 mm	69	31	31
No. 30	0.60 mm	44	56	56
No. 50	0.30 mm	18	82	82
No. 100	0.15 mm	4	96	96
				= 278
				FM = 2.78

REPORT

Results shall be reported on standard forms approved for use by the agency. Depending on the agency, this may include:

- Cumulative mass retained on each sieve
- Cumulative percent retained on each sieve
- Percent passing and retained on each sieve shall be reported to the nearest 1 percent except for the percent passing the U.S. No. 200 (75 µm) sieve, which shall be reported to the nearest 0.1 percent
- FM to the nearest 0.01 percent for WSDOT Class 2 Sand

Report results using WSDOT Form 422-020, or other report approved by the State Materials Engineer.

Performance Exam Checklist

WAQTC FOP FOR AASHTO T 27/T 11
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES

Participant Name ______________________ Exam Date ______________

Procedure Element	Yes	No
1. The tester has a copy of the current procedure on hand?	❒	❒
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?	❒	❒
3. Minimum sample mass meets requirement of Table 1 or from FOP for AASHTO T308?	❒	❒
4. Test sample dried to a constant mass by FOP for AASHTO T 255?	❒	❒
5. Test sample cooled and mass determined to nearest 0.1 percent of mass?	❒	❒
6. Sample placed in container and covered with water? (If specification requires that the amount of material finer than the No. 200 sieve is to be determined.)	❒	❒
7. Dispersing Agent used for HMA?	❒	❒
8. Contents of the container vigorously agitated?	❒	❒
9. Complete separation of coarse and fine particles achieved?	❒	❒
10. Wash water poured through nested sieves such as No. 10 and No. 200?	❒	❒
11. Operation continued until wash water is reasonably clear?	❒	❒
12. Material retained on sieves returned to washed sample?	❒	❒
13. Washed aggregate dried to a constant mass by FOP for AASHTO T 255?	❒	❒
14. Washed aggregate cooled and mass determined to nearest 0.1 percent of mass?	❒	❒
15. Sample placed in nest of sieves specified? (Additional sieves may be used to prevent overloading as allowed in FOP.)	❒	❒
16. Material sieved in verified mechanical shaker for minimum of 10 minutes or for the minimum verified time whichever is longer?	❒	❒
17. Mass of residue on each sieve determined to 0.1 percent of mass?	❒	❒
18. Total mass of material after sieving agrees with mass before sieving to within 0.3 percent, or 0.2 percent for HMA (per FOP for AASHTO T308)?	❒	❒
19. Percentages calculated to the nearest 0.1 percent and reported to the nearest whole number, except No. 200 - reported to the nearest 0.1 percent?	❒	❒
20. Percentage calculations based on original dry sample mass?	❒	❒
21. Calculations performed properly? If material passing No. 4 sieve is split and only a portion is tested, calculation as noted in FOP performed properly?	❒	❒

First attempt: Pass ❒ Fail ❒ Second attempt: Pass ❒ Fail ❒

Signature of Examiner ______________________________

Comments:

Washington State
Department of Transportation

WSDOT Test Method T 716

Method of Random Sampling for Locations of Testing and Sampling Sites

1. SCOPE

   a. This method outlines the procedure for selecting sampling and testing sites in accordance with accepted random sampling techniques. It is intended that all testing and sampling locations be selected in an unbiased manner based entirely on chance.

   b. Testing and sampling locations and procedures are as important as testing. For test results or measurements to be meaningful, it is necessary that the sampling locations be selected at random, typically by use of a table of random numbers. Other techniques yielding a system of randomly selected locations are also acceptable.

   c. This procedure is divided into several sections:
      - Applications for Hot Mixture Asphalt Density
      - Applications for Hot Mixture Asphalt (HMA) Sampling
      - Applications for Portland Cement Concrete
      - Applications for Aggregate and other materials

2. PROCEDURE

   a. Determine the lot, or sublot size and number of tests required for material being tested or sampled.

   b. Select a two digit number at random. Use the random number as the entry point into the random number table.

      Note: A recommended procedure for selecting a random number is stated in each of the categories of material in Section 4 Calculations.

   c. Determine multipliers for testing/sampling locations using Table 1 to calculate "X" and "Y" coordinates or Table 2 to calculate tonnage (X only).

3. CALCULATIONS

   a. Hot Mix Asphalt Density

      1. To determine a testing site location, calculate the tons/linear foot distance as follows:

         $$\text{Tons per linear foot} = \frac{1.0\text{ ft} * \text{width (feet)} * \text{depth (feet))} * 2.05\text{ Tons/cy}}{27}$$

         $$\text{Sublot length} = \frac{tons}{tons\ per\ linear\ ft}$$

         Example:

         Pavement-12 ft wide, 0.15 ft deep, 80 ton sublot

$$\text{Tons per linear Foot} = \frac{1.0 \text{ ft} * 12 \text{ ft} * 0.15 \text{ ft} * 2.05 \text{ tons}}{27} = 0.137 \text{ Tons per linear Foot.}$$

$$\text{Sublot length} = \frac{80 \text{ Tons}}{0.137 \text{ Tons per linear Foot}} = 583.9 \text{ lf (round to 584 lf)}$$

2. Choose a number at random (see section 3b) to enter Table 1. The recommended method for choosing a random number for HMA density is to use the last two digits from the most recent standard count on the nuclear gauge.

3. Determine the test station and offset as follows:

   Test Station = (sublot length * “X” multiplier) + beginning station of paving

   Offset (from right side of pavement) = (width of pavement * “Y” multiplier)

   Note: The values in the table have been set so that no measurements are taken within 1.5 LF of the edge of the lane. When a test falls within an area that is not appropriate for a test location (i.e. a bridge end, track crossing, night joint) move the testing location 25 lf ahead or back on stationing, as appropriate.

   Example:

   Beginning Station= 168 + 75

   Width = 12 ft

   Sublot length = 584

   Ending Station= (Beginning Station + Sublot length) = (16875 + 584)=174 +59

   Standard Count = 2951

   Beginning Test Location

   Enter table at line (51): “X” multiplier = 0.762, “Y” multiplier = 0.65

   Stationing = (584 * 0.762) + 16875 = 173 +20

   Offset = (12 * 0.65) = 7.8 ft

4. Determine subsequent testing locations as follows:

   Enter the random number table on the next line in sequence (if original table entry 51, next line entry 52, then 53, etc.)

   New beginning station = previous ending station ~~+ sublot length~~

   X coordinate = (sublot length * “X” multiplier) + New beginning station

   Y coordinate = (width of pavement * “Y” multiplier)

   Example:

   Second Test Location

   New beginning station = 174+59
   Enter table at line (52): “X” multiplier = 0.762, “Y” multiplier = 0.65
   Test station = (584 * 0.285) + 17459 = 176 +25
   Offset = (12 * 0.28) = 3.4 ft from right edge

Y values are selected so that lateral locations are no closer than 1.5 feet (0.45m) from the edge of a paving lane.

Sequence	X	Y	Sequence	X	Y	Sequence	X	Y	Sequence	X	Y
1	0.290	0.33	26	0.657	0.69	51	0.762	0.65	76	0.434	0.43
2	0.119	0.43	27	0.761	0.27	52	0.285	0.28	77	0.832	0.71
3	0.694	0.32	28	0.389	0.69	53	0.347	0.87	78	0.044	0.73
4	0.722	0.47	29	0.751	0.20	54	0.962	0.75	79	0.235	0.28
5	0.784	0.39	30	0.191	0.77	55	0.203	0.60	80	0.271	0.62
6	0.953	0.15	31	0.006	0.50	56	0.803	0.35	81	0.477	0.85
7	0.576	0.14	32	0.456	0.23	57	0.672	0.17	82	0.267	0.44
8	0.069	0.74	33	0.367	0.85	58	0.306	0.20	83	0.933	0.28
9	0.691	0.86	34	0.025	0.73	59	0.223	0.83	84	0.974	0.87
10	0.973	0.44	35	0.299	0.33	60	0.116	0.58	85	0.600	0.46
11	0.328	0.5	36	0.194	0.25	61	0.768	0.32	86	0.591	0.19
12	0.468	0.78	37	0.936	0.37	62	0.893	0.37	87	0.165	0.77
13	0.183	0.44	38	0.231	0.71	63	0.504	0.66	88	0.668	0.41
14	0.669	0.36	39	0.050	0.74	64	0.043	0.31	89	0.327	0.29
15	0.971	0.71	40	0.584	0.43	65	0.284	0.39	90	0.473	0.51
16	0.336	0.37	41	0.172	0.87	66	0.196	0.15	91	0.598	0.58
17	0.314	0.78	42	0.430	0.87	67	0.742	0.66	92	0.373	0.69
18	0.508	0.44	43	0.704	0.19	68	0.941	0.43	93	0.244	0.24
19	0.347	0.20	44	0.009	0.18	69	0.531	0.31	94	0.831	0.14
20	0.877	0.85	45	0.552	0.17	70	0.478	0.56	95	0.178	0.45
21	0.712	0.17	46	0.626	0.29	71	0.228	0.37	96	0.821	0.46
22	0.193	0.17	47	0.144	0.62	72	0.008	0.48	97	0.124	0.62
23	0.976	0.69	48	0.246	0.13	73	0.002	0.17	98	0.580	0.57
24	0.997	0.63	49	0.055	0.40	74	0.330	0.42	99	0.037	0.24
25	0.930	0.44	50	0.678	0.66	75	0.089	0.20	100	0.700	0.59

Random Numbers with X and Y value
Table 1

b. HOT MIX ASPHALT (HMA) PAVEMENT MIXTURE

1. Determine the sublot increment of the material.
2. Choose a number at random to enter Table 2. The recommended method for choosing a random number for HMA mix is to use the last two digits of the ignition furnace calibration.
3. Determine the test location by tonnage.
4. Calculate the first test location as follows:

   Sampling Site = Sublot increment * "X" multiplier (Table 2)

   Example:

   The Ignition Furnace Calibration is 0.45%. Use 45 as the starting point to enter random number Table 2. "X"=0.604.

First test location:

Sublot increment = 800 tons
Beginning tonnage: 0
Sublot increment: 800 * 0.604 = 483
Test tonnage Sample 1: Beginning tonnage + 483 tons = 483 tons

Random sample tonnage may be adjusted per sublot to accommodate field testing. Adjustments to random sample tonnage should be documented.

e. Determine subsequent test locations as follows:

The new beginning tonnage is calculated by adding the sublot increment tonnage to the previous test tonnage.

Enter the Table 2 on the next line in sequence (if beginning entry 45, next line entry 46, next 47, etc.)

Example:

Second test location:

Enter Table 2 at (46) "X" = 0.087
Sublot increment: 800 * 0.087 = 70
Testing tonnage Sample 2: 800 + 70 = 870 tons

X	X	X	X	X
(1) 0.186	(21) 0.256	(41) 0.201	(61) 0.508	(81) 0.431
(2) 0.584	(22) 0.753	(42) 0.699	(62) 0.884	(82) 0.509
(3) 0.965	(23) 0.108	(43) 0.785	(63) 0.648	(83) 0.962
(4) 0.044	(24) 0.626	(44) 0.874	(64) 0.398	(84) 0.315
(5) 0.840	(25) 0.885	(45) 0.604	(65) 0.142	(85) 0.721
(6) 0.381	(26) 0.418	(46) 0.087	(66) 0.962	(86) 0.637
(7) 0.756	(27) 0.320	(47) 0.334	(67) 0.516	(87) 0.056
(8) 0.586	(28) 0.098	(48) 0.189	(68) 0.615	(88) 0.905
(9) 0.480	(29) 0.791	(49) 0.777	(69) 0.226	(89) 0.195
(10) 0.101	(30) 0.717	(50) 0.704	(70) 0.881	(90) 0.981
(11) 0.282	(31) 0.868	(51) 0.946	(71) 0.369	(91) 0.600
(12) 0.957	(32) 0.583	(52) 0.426	(72) 0.001	(92) 0.044
(13) 0.377	(33) 0.385	(53) 0.266	(73) 0.744	(93) 0.433
(14) 0.456	(34) 0.465	(54) 0.791	(74) 0.229	(94) 0.762
(15) 0.778	(35) 0.101	(55) 0.711	(75) 0.906	(95) 0.678
(16) 0.243	(36) 0.285	(56) 0.122	(76) 0.413	(96) 0.347
(17) 0.578	(37) 0.829	(57) 0.895	(77) 0.827	(97) 0.274
(18) 0.966	(38) 0.998	(58) 0.371	(78) 0.984	(98) 0.114
(19) 0.373	(39) 0.539	(59) 0.221	(79) 0.641	(99) 0.480
(20) 0.834	(40) 0.060	(60) 0.011	(80) 0.068	(100) 0.685

Random Numbers
Table 2

c. PORTLAND CEMENT CONCRETE (PCC)

1. Determine the sublot increment for the random test sample. A sublot for PCC is based on a sampling frequency of one in five trucks after, two successive trucks within specification.

   Sublot increment = Cubic Yards per truck * 5 trucks

   Example

   Each truck carries 10 CY of concrete

   Sublot Increment = 10 CY * 5 trucks = 50 CY

2. Choose a two digit number at random to enter Table 2. The recommended method for choosing a random number for Portland Cement Concrete is to choose the last two digits from the first civilian license plate seen that day (do not use vehicles associated with the project site).

   Note: Start each day of concrete placement with an new "X" value determined by chance in order to obtain a random selection

3. Determine the sample location as follows:

   Sampling Location = Sublot increment * "X" multiplier (Table 2)

   Example:

   The civilian license plate ends in 37. Use 37 as the starting point to enter random number Table 2 "X"= 0.829.

   Sample location = 50 CY x 0.829 = 41 CY

4. Determine where the first sample will be taken:

   Sample Yardage = (CY per truck * 2 (for the first two trucks)) + Sample location

   Example:

   First sample location:
   Sample location = (10 CY *2) + 41 CY = 61 CY

5. The sample will be taken from the truck containing the 61st CY or in this example the seventh truckload of the pour. Allow approximately ½ CY of concrete to be discharged before sampling the truck.

   Example

   (41 /10) CY= 4.1 trucks + original 2 truck = 6.1 trucks

   Sample is located in the first 1/3 of the 7th truck of the pour.

6. Determine subsequent sampling locations as follows:

   Example:

   Second sample location:
   Use the next sequential line of the chart after the beginning random number. Original number was 37 use line (38) as the starting point to enter random number Table 2. "X"= 0.998.

   Sample location = 50 CY x 0.998 = 49.9 CY = 50 CY

7. The second sample will be taken at 120 CY

   Example

   20 CY (first two trucks) + 50 (first random sample of 5 trucks) + 50 CY

   The sample would come from the last ⅓ of the truck 12th truck of the pour.

d. AGGREGATE AND OTHER MATERIALS

1. Determine the lot or sublot size according to the contract documents. The lot or sublot shall be determined to the nearest 100 tons.

2. Choose a two digit number at random to enter Table 2. The recommended method for choosing a random number for Aggregates and other materials not described above is to choose the last two digits from the first civilian license plate seen that day (do not use vehicles associated with the project site) or use a digital stopwatch. To use the stop watch method; start the stop watch and let it count for several seconds, stop the watch and use the decimal part of the seconds as your entry point.

3. Determine the sample location as follows:

   Sampling Location = lot or Sublot size * "X" multiplier (Table 2)

   Sampling from a Belt or Flowing Stream: The specification calls for one sample from every 1000 Tons of aggregate. If the random number is (58), "X"= 0.371,

   Example:

   First sample location

   (0.371) (1000 Tons) = 371 Tons.

   Sample the material when the 371th ton passes over the belt.

   Second sample location

   Entry line will be (59), "X"= 0.221

   (0.221) (1000 Tons) = 221 Tons

   Sample site= 371 + 221 = 592

   Sample the material when the 592nd ton passes over the belt.

   Sampling from Haul Units: If the contract documents require samples based on number of haul units. Determine the number of hauling units that comprise a lot. Multiply the selected random number(s) by the number of units to determine which unit(s) will be sampled.

Example:

Lot size = 20 haul units

If the random number is (58), “X”= 0.371,

First sample location

(0.371) (20) = 7.42 haul units.

Sample is taken from the 7th haul unit

Second sample location

Entry line will be (59), “X”= 0.221

(0.221) (20) = 4.42 haul units

Sample site= 20 + 4.42 = 24.42

Sample the material when the 24th haul unit

Sampling from a Roadway with Previously Placed Material: Determine the sample location in the same manner as Section 4 (A) Hot Mix Density.

APPPENDIX A

HOT MIX ASPHALT DENSITY AND CHALLENGE CORES (400 TON LOTS)

a. Determine the LOT size and number of tests per LOT. The Standard specifications set the size of a density test lot for Hot Mix Asphalt Pavement to no greater than a single day's production or 400 tons, whichever is less, and require five tests per LOT. At the end of a day's production the final lot may be increased to a maximum of 600 tons.

b. Convert this LOT size to an area segment of the roadway based on the roadway section and depth being constructed for the course being tested. The calculations in Example 1 show how this is performed. Table A1 has been provided to give you recommend lot lengths for standard lane widths at various depths. Lot length needs to be determined to the nearest 100 feet.

Example 1
Sample Computation for Lot Length

Using nominal compacted density of 2.05 tons/cy, and a 400 ton lot:

$$\text{Tons per linear foot} = \frac{\text{1.0 (foot) * width (feet) * depth (feet)) * 2.05 Tons/cy}}{27}$$

$$\text{Tons per linear Foot} = \frac{\text{1.0 ft * 12 ft * 0.15 ft * 2.05 tons}}{27} = \text{0.137 Tons per linear Foot}$$

$$\text{Lot length} = \frac{\text{400 Tons}}{\text{0.137 Tons per linear Foot}} = \text{2900 linear Feet}$$

Lane Width	Compacted Depth	Computed Lot Length	Recommended Lot Length
12 feet	0.12	3655	3700
	0.15	2924	2900
	0.20	2193	2200
	0.25	1754	1800
11 feet	0.12	3987	4000
	0.15	3189	3200
	0.20	2392	2400
	0.25	1913	1900

Hot Mix Asphalt Density Test Lot Length 400 Ton lot at 2.05 tons/cubic yard
Table A1

LOT length may also be determined based on Nominal Designated LOT sizes. To utilize this concept, compacted mix volumes equivalent to the designated mix quantity per LOT have been determined using the nominal compacted unit weight of Hot Mix asphalt. These volumes are then converted into Density LOT lengths using the typical lane width and specified compacted depth.

c. Determine the locations of the test (or sampling) sites by using values from the random number table to determine the coordinate location on the roadway. In the table, use the "X" values as decimal fractions of the total length of the lot; use the "Y" values as fractions of the width, customarily measured from the right edge of the pavement. The values in the table have been set so that no measurements are taken within 1.5 LF (0.45 m) of the edge of the pavement. Whenever a test location is determined to fall within such an area (i.e., bridge end, track crossing, or night joint) the test location should be moved ahead or back on stationing, as appropriate, by 25 LF (8 m).

d. In order to determine which "X" and "Y" values should be used, enter the table on a line chosen by chance. Recommended procedure is selection of a line based on the last two digits from the most recent standard count on the nuclear density gage. Subsequent "X" and "Y" values are then taken from the lines that follow. Based on the specified sampling frequency, 20 lots can be accommodated by one cycle through the table. Start each shift with a set of values determined by chance in order to obtain random selection.

e. Example 2 shows the calculations for determining the testing location for asphalt pavement density.

Example 2
Test Location Within the LOT
for Hot Mix Asphalt Density

For the lot: (12 ft. wide, 0.15 ft. deep, starting at station 168 + 75 with paving -progressing ahead on station), Lot length was previously determined as 2,900 LF. Using the last two digits of the standard count, as in the example, 2951, assume "X" and "Y" values from line (51) in random number table: X = 0.762, Y = 0.65.

For the first test:

Beginning station: 168 + 75

Sublot length increment: 580 * 0.762 = 442

Width offset: 12 * 0.65 = 7.8 ft. (from right edge)

Location is: station: (168+75) + 442 = 173 + 17, 7.8 ft. from right edge

For the Second test:

Beginning station: (168 + 75) + (580) = 174 + 55

Sublot length increment: 580 * 0.285 = 165

Width offset: 12 * 0.28 = 3.4 ft. (from right edge)

Location is: station: (174 + 55) + 165 = (176 + 20), 3.4 ft. from right edge

For the Third test:

Beginning station: (168 + 75) + 580 + 580 = 180 + 35

Sublot length increment: 580 * 0.347 = 201

Width offset: 12 * 0.87 = 10.4 ft. (from right edge)

Location is: station: (180 + 35) + 201 = (182 + 36), 10.4 ft. from right edge

Appendix B

HOT MIX ASPHALT DENSITY AND CHALLENGE CORES (Milepost)

a. Determine the LOT size and number of tests per LOT. The Standard specifications set the size of a density test lot for Hot Mix Asphalt Pavement to no greater than a single day's production or 400 tons, whichever is less, and require five tests per LOT. At the end of a day's production the final lot may be increased to a maximum of 600 tons.

b. Convert this LOT size to an area segment of the roadway based on the roadway section and depth being constructed for the course being tested. The calculations in Example 1 show how this is performed. Table A2 has been provided to give you recommend lot lengths for standard lane widths at various depths. Lot length needs to be determined to the nearest .01 of a mile.

Example 1
Sample Computation for Lot Length

Using nominal compacted density of 2.05 tons/cy, and a 400 ton lot:

$$\text{Tons per linear foot} = \frac{(1.0\text{ (foot)} * \text{width (feet)} * \text{depth (feet)}) * 2.05\text{ Tons/cy}}{27}$$

$$\text{Tons per linear Foot} = \frac{1.0\text{ ft} * 12\text{ ft} * 0.15\text{ ft} * 2.05\text{ tons}}{27} = 0.137\text{ Tons per linear Foot.}$$

0.137 Tons per linear Foot * 5,280 ft = 723.36 Tons per mile

$$\text{Lot length} = \frac{400\text{ Tons}}{723.36\text{ Tons per mile}} = 0.55\text{ linear miles}$$

Lane Width	Compacted Depth	Computed Lot Length	Recommended Lot Length
12 feet	0.12	0.69	0.69
	0.15	0.55	.55
	0.20	0.42	.42
	.25	0.33	.034
11 feet	0.12	0.76	0.76
	0.15	0.60	0.61
	0.20	0.45	0.46
	0.25	0.35	0.36

Hot Mix Asphalt Density Test Lot Length
400 Ton lot at 2.05 tons/cubic yard
Table A2

LOT length may also be determined based on Nominal Designated LOT sizes. To utilize this concept, compacted mix volumes equivalent to the designated mix quantity per LOT have been determined using the nominal compacted unit weight of Hot Mix asphalt. These volumes are then converted into Density LOT lengths using the typical lane width and specified compacted depth. The included tables present the values for LOT Lengths based on mileposts.

c. Determine the locations of the test (or sampling) sites by using values from the random number table to determine the coordinate location on the roadway. In the table, use the "X" values as decimal fractions of the total length of the lot; use the "Y" values as fractions of the width, customarily measured from the right edge of the pavement. The values in the table have been set so that no measurements are taken within 1.5 LF (0.45 m) of the edge of the pavement. Whenever a test location is determined to fall within such an area (i.e., bridge end, track crossing, or night joint) the test location should be moved ahead or back on milepost, as appropriate, by .01 mile.

d. In order to determine which "X" and "Y" values should be used, enter the table on a line chosen by chance. Recommended procedure is selection of a line based on the last two digits from the most recent standard count on the nuclear density gage. Subsequent "X" and "Y" values are then taken from the lines that follow. Based on the specified sampling frequency, 20 lots can be accommodated by one cycle through the table. Start each shift with a set of values determined by chance in order to obtain random selection.

e. Example 2 shows the calculations for determining the testing location for asphalt pavement density.

Example 2
Test Location Within the LOT
for Hot Mix Asphalt Density

For the lot: (12 ft. wide, 0.15 ft. deep, starting at Milepost 1.00 with paving ¬progressing ahead on Milepost), Lot length was previously determined as 0.55 miles. Using the last two digits of the standard count, as in the example, 2951, assume "X" and "Y" values from line (51) in random number table: X = 0.762, Y = 0.65.

For the first test:

Beginning Milepost: 1.00
Sublot length increment: .11 * 0.762 = .08
Width offset: 12 * 0.65 = 7.8 ft. (from right edge)
Location is: Milepost: (1.00) + .08 = 1.08, 7.8 ft. from right edge

For the Second test:

Beginning Milepost: (1.00) + (.11) = 1.11
Sublot length increment: .11 * 0.285 = .03
Width offset: 12 * 0.28 = 3.4 ft. (from right edge)
Location is: Milepost: (1.11) + .03 = (1.14), 3.4 ft. from right edge

For the Third test:

Beginning Milepost: (1.00) + .11 + .11 = 1.22
Sublot length increment: .11 * 0.347 = .04
Width offset: 12 * 0.87 = 10.4 ft. (from right edge)
Location is: Milepost: (1.22) + .04 = (1.26), 10.4 ft. from right edge

Washington State
Department of Transportation

WSDOT SOP 723

Standard Operating Procedure for Submitting Hot Mix Asphalt (HMA) Mix Designs for Verification

1. Scope

    1.1 This standard covers the procedural steps required for submitting a HMA mix design for verification to the Bituminous Materials Section of the State Materials Laboratory.

    1.2 The values stated in English units are to be regarded as the standard.

    1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Approval of Material

    2.1 Approvals of the material for HMA are required prior to use per Standard Specification 1-06.1.

    2.2 A HMA mix design is required for each contract. HMA mix designs are only valid for a single construction season.

3. Referenced Documents

    3.1 WSDOT Standards:

    - WSDOT FOP for AASHTO T 2, Standard Practice for Sampling Aggregates
    - WSDOT Test Method T 724, Method of Preparation of Aggregate for Hot Mix Asphalt (HMA) Mix Designs
    - WSDOT *Standard Specifications* M 41-10

4. Procedure

    4.1 The Contractor shall determine a design aggregate structure and asphalt binder content in accordance with WSDOT Standard Operating Procedure 732.

    4.2 Once the design aggregate structure and asphalt binder content have been determined, the Contractor shall submit the HMA mix design on WSDOT form 350-042 demonstrating that the design meets the requirements of *Standard Specifications* 9-03.8(2) and 9-03.8(6).

    4.3 The Contractor shall obtain representative samples of aggregate per WSDOT FOP for AASHTO T 2 that will be used in the HMA production.

    4.4 The Contractor shall submit representative aggregate samples totaling 700 pounds proportioned to match the Contractor's proposal to the State Material's Laboratory for testing.

For example, if the Contractor's proposal consists of five stockpiles with the following blending ratio:

Material	Ratio
¾″ - #4	20%
½″ - #8	30%
⅜″ - #16	30%
#4 - 0	15%
Blend Sand	5%

Calculate the amount of aggregate needed from each stockpile in the following manner.

Material		Pounds of aggregate needed per stockpile
¾″ - #4	700 lbs x 0.20	140 pounds
½″ - #8	700 lbs x 0.30	210 pounds
⅜″ - #16	700 lbs x 0.30	210 pounds
#4 - 0	700 lbs x 0.15	105 pounds
Blend Sand	700 lbs x 0.05	35 pounds

5. Shipping Samples

5.1 Transport aggregate in bags or other containers so constructed as to preclude loss or contamination of any part of the sample, or damage to the contents from mishandling during shipment. The weight limit for each bag or container of aggregate is 30 pounds maximum.

5.2 Each aggregate bag or container shall be clearly marked or labeled with suitable identification including the contract number, aggregate source identification and size of stockpile material. Aggregate bags or containers submitted to the State Materials Laboratory shall be accompanied by a completed transmittal for each stockpile used in the HMA mix design and a completed copy of WSDOT Form 350-042.